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(54) **MAGNETIC HEAD SEPARATOR FIN MATERIAL TO PREVENT PARTICULATE CONTAMINATION ON SLIDER**

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CPC ... ***G11B 5/48*** (2013.01); ***G11B 5/54*** (2013.01)

(58) **Field of Classification Search**
USPC 360/254.7–254.9
See application file for complete search history.

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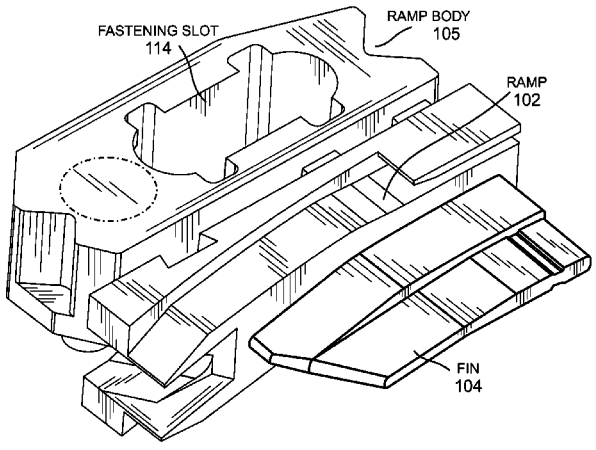
(57) **ABSTRACT**

An apparatus for a magnetic storage drive includes a magnetic head assembly having a first slider and a second slider arranged with a gap between the first and second sliders, the first slider comprising a first magnetic head and the second slider comprising a second magnetic head. The apparatus includes a ramp constructed of a first material, the ramp being configured to guide and hold the magnetic head assembly in place when parked; and a fin constructed of a second material different than the first material, the fin arranged with the ramp to protect the first slider from contacting the second slider when the magnetic head assembly is parked on the ramp.

24 Claims, 4 Drawing Sheets



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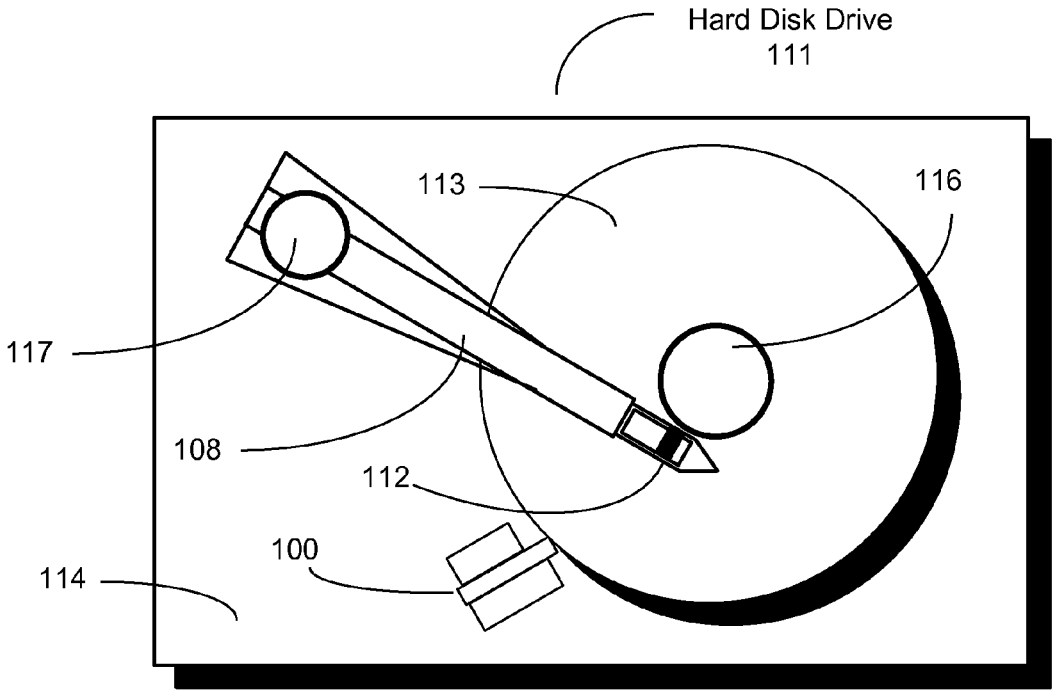

FIG. 1

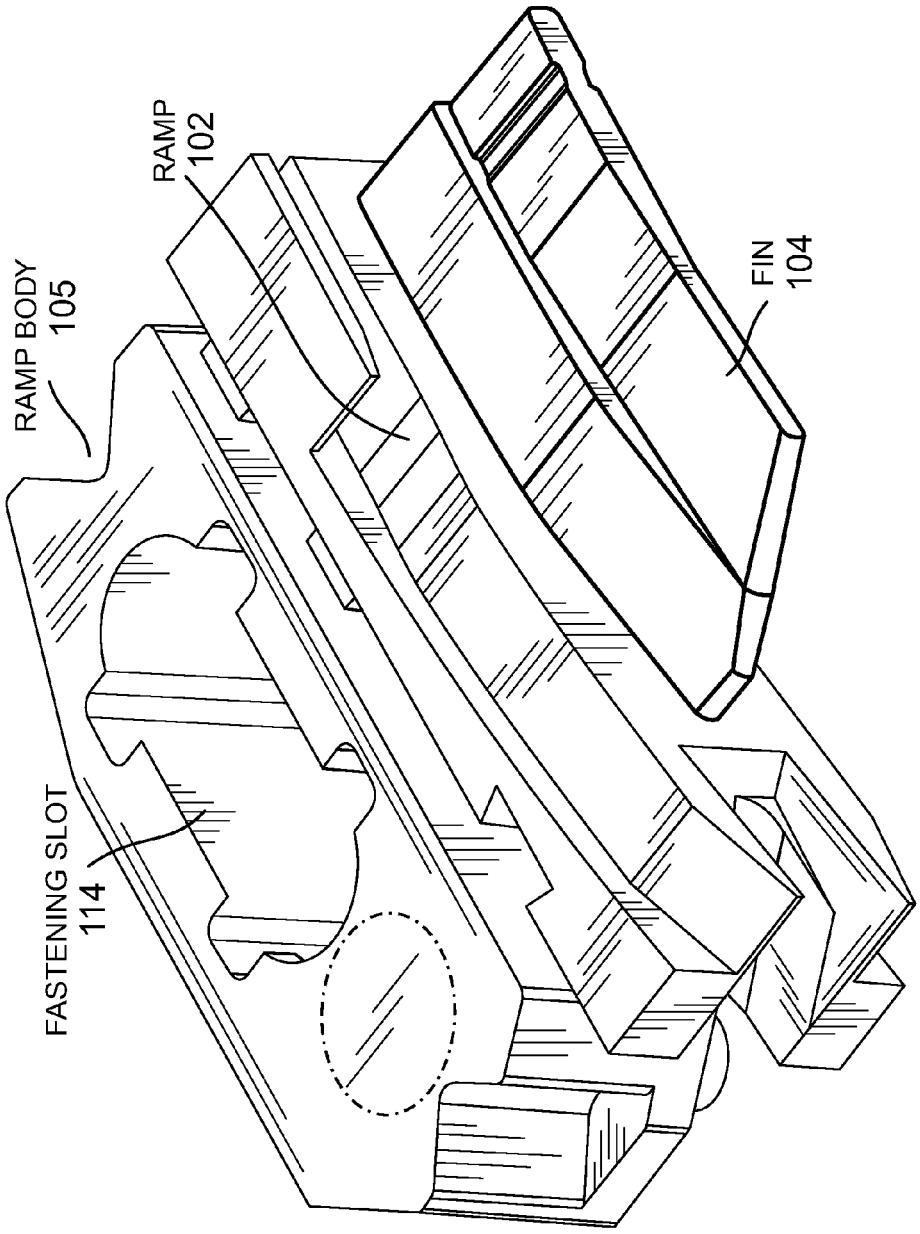

FIG. 2

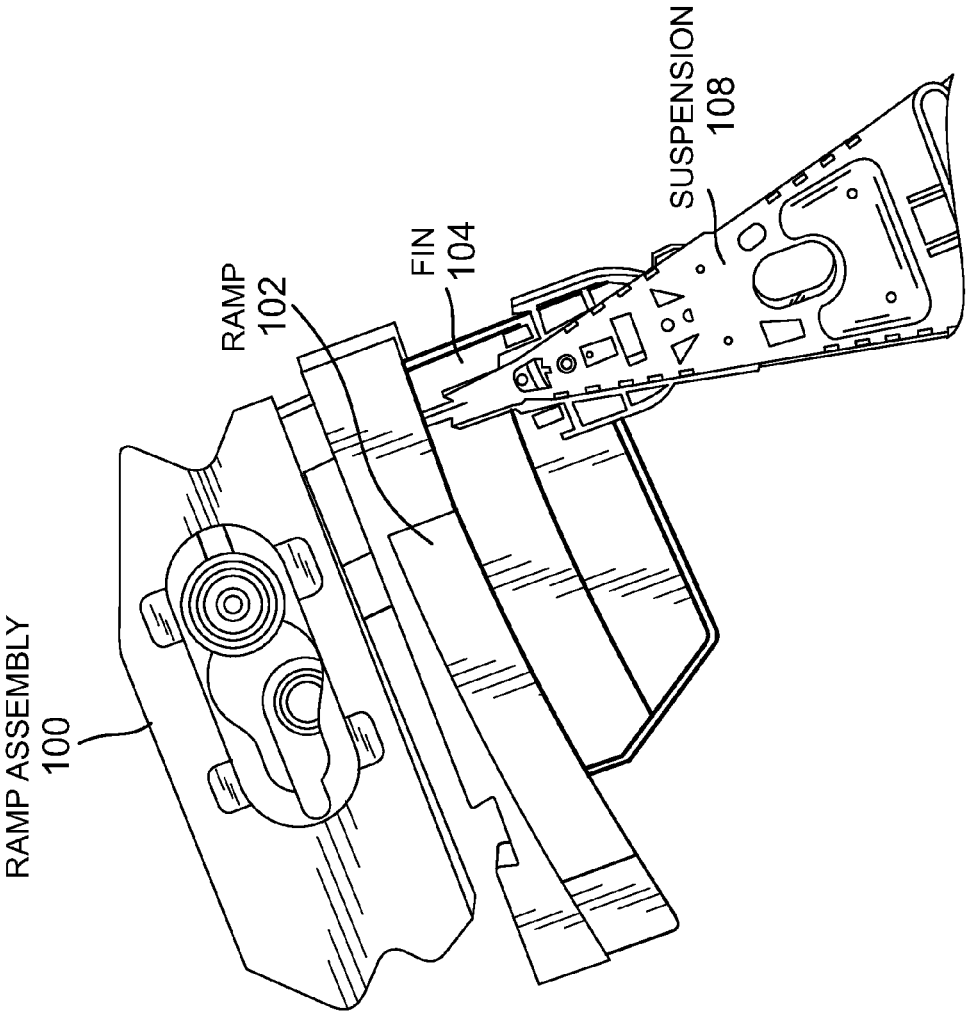

FIG. 3

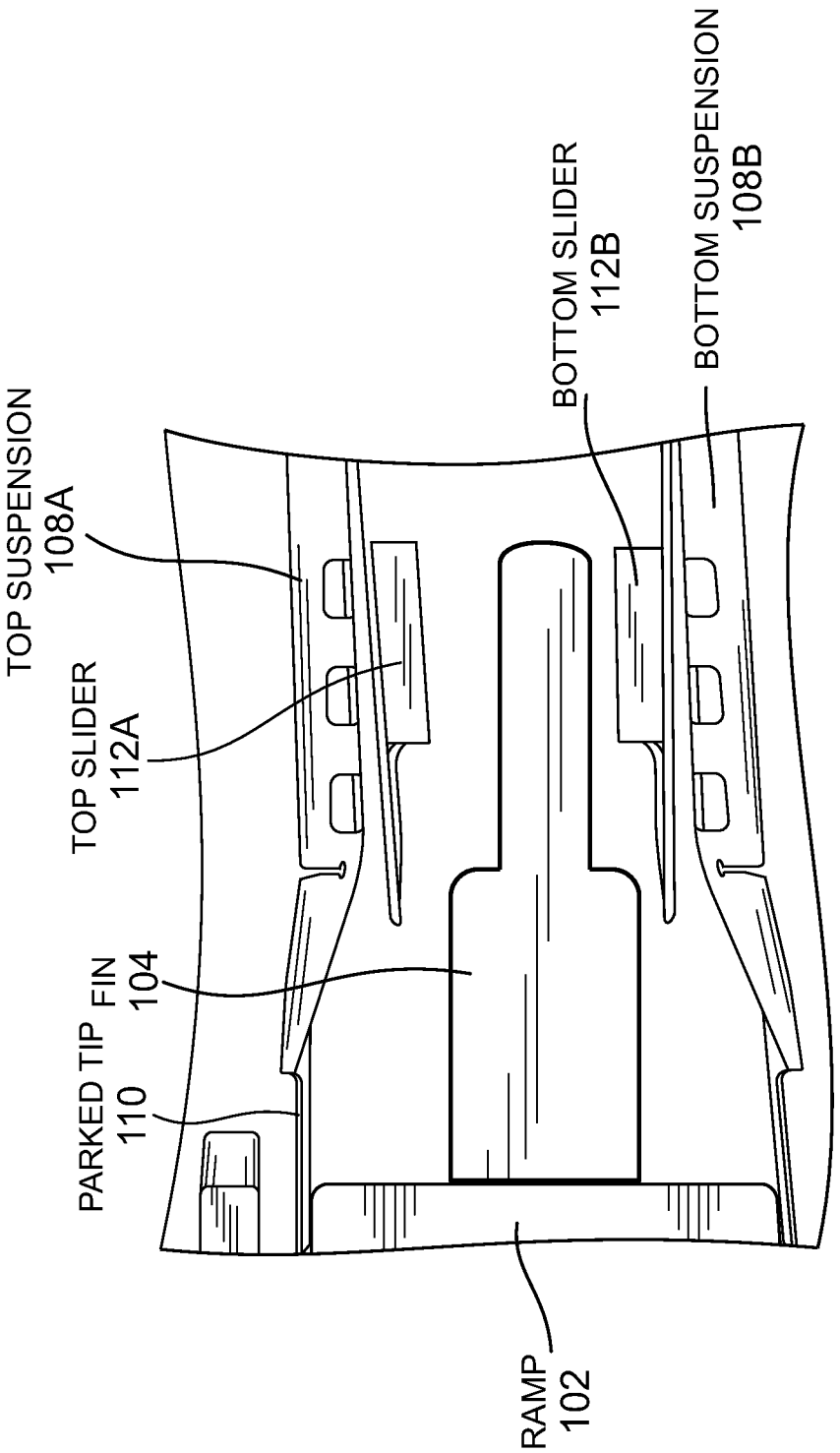
TOP SUSPENSION
108A
TOP SLIDER
112A
PARKED TIP
110
FIN
104
RAMP
102
BOTTOM SLIDER
112B
BOTTOM SUSPENSION
108B

FIG. 4

MAGNETIC HEAD SEPARATOR FIN MATERIAL TO PREVENT PARTICULATE CONTAMINATION ON SLIDER

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Application Ser. No. 61/951,997 filed on Mar. 12, 2014, which is expressly incorporated by reference herein in its entirety.

BACKGROUND

A hard disk drive includes a rotatable storage disk, with magnetic reader heads and writer heads that can be placed in park when the device is not actively reading or writing. A head assembly of reader and writer heads is positioned on a slider, which is a base substrate structure for the head assembly. A ramp is a structure designed to guide and seat a suspension arm for the head assembly when parking. An armature holding the head assembly rotates to an end position toward the ramp, allowing a tip assembly to engage with the ramp, with the head assembly kept at a clearance gap from the ramp. While in park, an opposing slider and head assembly, used for reading and writing on the opposite side of the storage disk, resides below the first slider and head assembly. In order to protect the opposing sliders from clashing with each other upon a shock event (e.g., if the device is dropped or bumped during or after assembly), a separator fin extends outward from the ramp into the space between the parked sliders. However, while the fin protects the top slider from contacting and damaging the bottom slider, small shock events may bring the top and/or the bottom slider into contact with the fin. This contact may leave debris deposits, such as particulate residue, from the fin material onto the slider, and may cause smearing on the slider. This residue and smearing may lead to contamination-related failures of the magnetic reader and writer heads.

BRIEF DESCRIPTION OF THE DRAWINGS

Various aspects of the present invention will now be presented in the detailed description by way of example, and not by way of limitation, with reference to the accompanying drawings, wherein:

FIG. **1** shows a diagram of an exemplary hard disk drive;

FIG. **2** shows a diagram of an exemplary ramp assembly with a fin structure composed of a different material;

FIG. **3** shows a top view detail of an exemplary ramp assembly with a fin structure in a relative position with a parked suspension arm of a head gimbal assembly; and

FIG. **4** shows a side view detail of an exemplary ramp assembly and fin arranged between top and bottom sliders in a parked position on the ramp.

DETAILED DESCRIPTION

The detailed description set forth below in connection with the appended drawings is intended as a description of various exemplary embodiments and is not intended to represent the only embodiments that may be practiced. The detailed description includes specific details for the purpose of providing a thorough understanding of the embodiments. However, it will be apparent to those skilled in the art that the embodiments may be practiced without these specific details. In some instances, well-known structures and components

are shown in block diagram form in order to avoid obscuring the concepts of the embodiments. Acronyms and other descriptive terminology may be used merely for convenience and clarity and are not intended to limit the scope of the embodiments.

The various exemplary embodiments illustrated in the drawings may not be drawn to scale. Rather, the dimensions of the various features may be expanded or reduced for clarity. In addition, some of the drawings may be simplified for clarity. Thus, the drawings may not depict all of the components of a given apparatus.

Various embodiments will be described herein with reference to drawings that are schematic illustrations of idealized configurations. As such, variations from the shapes of the illustrations as a result of manufacturing techniques and/or tolerances, for example, are to be expected. Thus, the various embodiments presented throughout this disclosure should not be construed as limited to the particular shapes of elements illustrated and described herein but are to include deviations in shapes that result, for example, from manufacturing. By way of example, an element illustrated or described as having rounded or curved features at its edges may instead have straight edges. Thus, the elements illustrated in the drawings are schematic in nature and their shapes are not intended to illustrate the precise shape of an element and are not intended to limit the scope of the described embodiments.

The word "exemplary" is used herein to mean serving as an example, instance, or illustration. Any embodiment described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other embodiments. Likewise, the term "embodiment" of an apparatus or method does not require that all embodiments include the described components, structure, features, functionality, processes, advantages, benefits, or modes of operation.

As used herein, the term "about" followed by a numeric value means within engineering tolerance of the provided value.

In the following detailed description, various aspects of the present invention will be presented in the context of a ramp assembly used to park a magnetic head assembly when idle in a disk-based storage device, such as a hard disk drive (HDD) or a solid state hybrid drive (SSHD).

An aspect of a ramp apparatus includes a ramp body constructed of a first material, the ramp being configured to guide and hold a magnetic head assembly in place when parked, and a fin being formed with a second material different than the first material. The fin is arranged with the ramp to protect a top magnetic head assembly from contacting a bottom magnetic head assembly during a shock event when parked on the ramp.

FIG. **1** shows a hard disk drive **111** including a disk drive base **114**, at least one rotatable storage disk **113** (such as a magnetic disk, magneto-optical disk, or optical disk), and a spindle motor **116** attached to the base **114** for rotating the disk **113**. The spindle motor **116** typically includes a rotating hub on which one or more disks **113** may be mounted and clamped, a magnet attached to the hub, and a stator. At least one suspension arm **108** supports at least one head gimbal assembly (HGA) **112** that holds a slider with a magnetic head assembly of writer and reader heads. A ramp assembly **100** is affixed to the base **114**, and provides a surface for tip of the suspension arm **108** to rest when the HGA **112** is parked (i.e., when the writing and reading heads are idle). During a recording operation of the disk drive **111**, the suspension arm **108** rotates at the pivot **117**, disengaging from the ramp assembly **100**, and moves the position of the HGA **112** to a desired information track on the rotating disk **113**. A typical hard disk

drive **111** uses double sided disks **113** to allow read/write operation on both sides of the disk **113**. As such, a second, opposing HGA **112** supported by a second suspension arm **108** (both are not visible in FIG. **1**) may be arranged on the underside of the disk **113**. The bottom of the ramp **100** may be configured with a surface that accepts the tip of the second suspension arm **108** when the second HGA **112** is parked.

FIG. **2** shows a diagram of an exemplary ramp assembly **100**, having a ramp body **105** with a ramp **102** and a fastening slot **114**. The ramp assembly **100** also includes a fin **104**, which is a means for protecting opposing sliders from contacting each other when the sliders and magnetic head assemblies are parked on the ramp. The fin **104** is a protruding structure that extends from the ramp body **105** in a suspended position between the opposing sliders when parked. As shown in FIG. **2**, the fin **104** may be configured in a rectangular shape and a thin vertical profile which conforms to the space between the sliders and the boundaries of the suspended slider position. The relative position of the fin **104** to the sliders will be explained in further detail below with respect to FIG. **3** and FIG. **4**.

The material composition of the ramp body **105** may be a durable and resilient plastic material having a hardness suitable for a rigid base to support one or more HGAs **112** and respective suspension arms **108**. Also, the ramp body **105** material composition should have a coefficient of friction low enough to permit free and unhindered sliding of the tip of suspension arm **108** on and off of the ramp **102** for entering and leaving the parked position. For example, the material composition of the ramp body **105** may be polyoxymethylene (POM). The material composition of the ramp body **105** may be either POM alone, or a compound that is primarily POM.

The material composition of the fin **104** may be a plastic material selected according to predetermined thresholds hardness, durability, and low material transfer (e.g., residue smearing) on contact. Additional criteria for the material may include a hardness value below a maximum hardness threshold to avoid chipping the slider during a shock event or generating debris from reinforcing fillers or fibers or the main plastic material. For example, the material formulations for the fin **104** may exhibit hardness in a range of about 95-130 (Rockwell M), and a tensile modulus higher than about 2.5 GPa with a limit at about 10 GPa.

In one embodiment, the material composition of the ramp body is different than the material composition of the fin **104**. For example, the ramp body **105** may be constructed of POM, and the fin **104** may be constructed of a material that is substantially free of POM, such as polyetherimide (PEI). In this example, the ramp assembly **100** may be fabricated in a two shot mold injection process for a POM based ramp body **105** and a PEI based fin **104**. Alternative materials for the fin **104** material composition may include any one of the following: polyetheretherketone (PEEK), polyphenylene sulfide (PPS), polyethersulfone (PES), polyimide, polyamide-imide.

The ramp body **105** and fin **104** may be affixed to each other in any one of various techniques, including but not limited to fusion bonding, solvent bonding, ultrasonic boding, a mechanical fastener, or fastening elements formed into each part (e.g., threaded elements, detents, etc.).

FIG. **3** shows a top view of the ramp assembly **100** with the suspension arm **108** parked on the ramp **102**. The slider (not visible) is affixed to the head gimbal assembly which is supported by the suspension arm **108**. The slider is suspended just above the surface of the fin **104** with a small clearance. The suspension arm **108** slides to the left to leave the parked position, and slides back over the ramp **102** to return to the parked position as shown. As shown in FIG. **3**, the fin **104** may be configured with a shape that conforms to the adjacent ramp **102** for providing protection between the opposing sliders along the length of the ramp **102** as the suspension **108** approaches and departs the ramp **102**. The length of the fin **104** may be approximately equivalent to the length of the ramp **102**, with a minimum length corresponding to the boundary of the suspended sliders when parked.

FIG. **4** shows a side view of the same ramp assembly **100** as shown in FIG. **3** with the suspension arm **108** parked on the ramp **102**. In this view as shown in FIG. **4**, both the top suspension arm **108**A and bottom suspension arm **108**B are visible. Also shown is the parked tip **110** of the suspension arm **108**A, which rests on the surface of ramp **102**. The fin **104** is arranged between the top slider **112**A and the bottom slider **112**B, which prevents two sliders from contacting each other during a shock event while in the parked position. The fin **104** may be configured with a width (i.e., the dimension extending out perpendicular and away from the ramp **102**) that corresponds with the boundary of the suspended sliders **112**A and **112**B, which are shown suspended from suspension arm **108**. The fin **104** may also be configured with a maximum thickness that provides clearance for the sliders **112**A and **112**B to pass above and below the fin **104** when being parked by the suspension arms **108**A and **108**B without contacting the fin **104**, and a minimum thickness that provides adequate sturdiness to protect the sliders upon contact with the fin **104** during a shock event.

With the fin **104** positioned as shown in FIG. **4**, the top slider **112**A or the bottom slider **112**B, or both, may contact the fin **104** in response to a vibration or shock event to the hard disk drive assembly **111** (e.g., external forces from the environment, such as a bump to the hard disk drive **111** during manufacturing, assembly, or operation), thus protecting against direct slider to slider contact. Constructing the fin **104** with a non-POM material, the top slider **112**A and the bottom slider **112**B may remain free from deposits, such as particulate residue, from the fin **104** material onto the sliders **112**A, **112**B, or substantially free of such deposits, for an extended service life of the read and write heads on sliders **112**A and **112**B.

The various aspects of this disclosure are provided to enable one of ordinary skill in the art to practice the present invention. Various modifications to exemplary embodiments presented throughout this disclosure will be readily apparent to those skilled in the art, and the concepts disclosed herein may be extended to other devices. Thus, the claims are not intended to be limited to the various aspects of this disclosure, but are to be accorded the full scope consistent with the language of the claims. All structural and functional equivalents to the various components of the exemplary embodiments described throughout this disclosure that are known or later come to be known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the claims. Moreover, nothing disclosed herein is intended to be dedicated to the public regardless of whether such disclosure is explicitly recited in the claims. No claim element is to be construed under the provisions of 35 U.S.C. §112(f) unless the element is expressly recited using the phrase "means for" or, in the case of a method claim, the element is recited using the phrase "step for."

What is claimed is:

1. An apparatus for a magnetic storage drive comprising a magnetic head assembly having a first slider and a second slider arranged with a gap between the first and second slid-

ers, the first slider comprising a first magnetic head and the second slider comprising a second magnetic head, the apparatus comprising:

a ramp constructed of a first material, the ramp being configured to guide and hold the magnetic head assembly in place when parked; and

a fin constructed of a second material different than the first material, the fin coupled to the ramp and arranged between the first slider and the second slider to protect the first slider from contacting the second slider while maintaining a clearance to each of the first slider and the second slider when the magnetic head assembly is parked on the ramp.

2. The apparatus of claim **1**, wherein the second material is substantially free of polyoxymethylene.

3. The apparatus of claim **1**, wherein the second material has a hardness in a range of about 95-130 Rockwell M.

4. The apparatus of claim **1**, wherein the second material has a tensile modulus greater than about 2.5 GPa and less than about 10 GPa.

5. The apparatus of claim **1**, wherein the second material comprises a polyetherimide (PEI) material.

6. The apparatus of claim **1**, wherein the second material comprises a polyetheretherketone (PEEK) material.

7. The apparatus of claim **1**, wherein the second material comprises a polyphenylene sulfide (PPS) material.

8. The apparatus of claim **1**, wherein the second material comprises a polyethersulfone (PES) material.

9. The apparatus of claim **1**, wherein the second material comprises a polyimide material.

10. The apparatus of claim **1**, wherein the second material comprises a polyamide-imide material.

11. The apparatus of claim **1**, wherein the fin extends from the ramp along a gap between the first slider and the second slider when the magnetic head assembly is parked on the ramp.

12. An apparatus for a magnetic storage drive comprising a magnetic head assembly having a first slider and a second slider arranged with a gap between the first and second sliders, the first slider comprising a first magnetic head and the second slider comprising a second magnetic head, the apparatus comprising:

a ramp constructed of a first material and configured to guide and hold the magnetic head assembly in place when parked; and

means for protecting the first slider from contacting the second slider, the means for protecting being arranged between the first slider and the second slider while maintaining a clearance to each of the first slider and the second slider when the magnetic head assembly is parked on the ramp;

wherein the means for protecting is constructed of a second material different than the first material.

13. The apparatus of claim **12**, wherein the second material comprises material substantially free of polyoxymethylene.

14. The apparatus of claim **12**, wherein the second material comprises material having a hardness in a range of about 95-130 Rockwell M.

15. The apparatus of claim **12**, wherein the second material comprises material having a tensile modulus greater than about 2.5 GPa and less than about 10 GPa.

16. The apparatus of claim **12**, wherein the second material comprises a polyetherimide (PEI) material.

17. The apparatus of claim **12**, wherein the second material comprises a polyetheretherketone (PEEK) material.

18. The apparatus of claim **12**, wherein the second material comprises a polyphenylene sulfide (PPS) material.

19. The apparatus of claim **12**, wherein the second material comprises a polyethersulfone (PES) material.

20. The apparatus of claim **12**, wherein the second material comprises a polyimide material.

21. The apparatus of claim **12**, wherein the second material comprises a polyamide-imide material.

22. The apparatus of claim **12**, wherein the means for protecting extends from the ramp along a gap between the first slider and the second slider when the magnetic head assembly is parked on the ramp.

23. A magnetic storage drive, comprising:

a rotatable storage disk;

a first slider with a first magnetic head assembly and a second slider with a second magnetic head assembly arranged with a gap between the first and second sliders for allowing passage across opposing sides of the storage disk, the first slider comprising a first magnetic head and the second slider comprising a second magnetic head;

a ramp constructed of a first material, the ramp being configured to guide and hold the first magnetic head assembly and the second magnetic head assembly in place when parked; and

a fin constructed of a second material different than the first material, the fin coupled to the ramp and arranged between the first slider and the second slider to protect the first slider from contacting the second slider while maintaining a clearance to each of the first slider and the second slider when the first magnetic head assembly and the second magnetic head assembly are parked on the ramp.

24. An apparatus for a magnetic storage drive comprising a magnetic head assembly having a first slider and a second slider arranged with a gap between the first and second sliders, the first slider comprising a first magnetic head and the second slider comprising a second magnetic head, the apparatus comprising:

a ramp constructed of a first material, the ramp being configured to guide and hold the magnetic head assembly in place when parked; and

a fin constructed of a second material different than the first material, the fin coupled to the ramp and arranged between the first slider and the second slider to protect the first slider from contacting the second slider when the magnetic head assembly is parked on the ramp, wherein the second material is substantially free of polyoxymethylene.

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